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RAW SUGAR PRICES, AT NEW YORK, OCTOBER 14 TO NOVEMBER 14, 1909.

Date.	96° Centrifugals		88° Beets	
	per lb.	per ton	per 100 wt.	per ton
Oct. 14	4.25¢	$85.00	11s 3¾d	$87.80
" 15	4.25¢	85.00	11s 1½d	87.00
" 16	....	....	11s 1½d	87.00
" 19	4.27½¢	85.50	11s	86.40
" 22	4.28⅓¢	85.66⅔	.....	.....
" 23	....	....	11s 1½d	87.00
" 24	....	....	11s	86.40
" 25	....	....	11s 6d	88.60
" 26	....	....	11s 5¼d	88.40
" 27	....	....	11s 7½d	89.20
" 28	....	....	11s 9d	89.80
Nov. 1	4.36¢	87.20	11s 9¾d	90.00
" 3	4.30¢	86.00	11s 6d	88.60
" 4	....	....	11s 9d	89.80
" 8	....	....	11s 9¼d	90.00
" 9	4.36¢	87.20	11s 9¾d	90.00
" 11	....	....	12s 3d	91.80
" 12	....	....	12s 4½d	92.40
" 14	....	....	12s 6d	93.00

THE SUGAR MARKET.

The outlook for the sugar market for 1910 is good.

The visible supply everywhere is less than it was last year at this time, and estimates of crops for 1910 are either about the same or less than for 1909, while consumption continues to increase in all countries.

There is good reason to expect that the price of sugar will average as well, if not better, during 1910, as it did during 1909.

In Hawaii, the growing season has been good. In a few districts the rainfall has been below the normal; but the estimates throughout the Territory are for a crop for 1910 as large as for 1909, which was the record to date, being ———— short tons.

Willett & Gray, as of November 11, 1909, reports that in the four ports of New York, Boston, Philadelphia and Baltimore, there were only 12,852 tons of raw sugar in importers' hands, as against 17,099 at same date 1908.

The total stocks of raw sugar in the hands of refiners at the last named four ports and New Orleans, was 134,227 tons, as against 239,194 tons on same date last year.

Total stocks on hand at New Orleans, Nov. 6, 11,889 tons as against 18,174 tons same date last year.

The total estimated afloats to the United States from Cuba and West Indies, 5,000 tons; Hawaii, 3,000 tons; Java, 35,000 tons; Philippines, Peru, Louisiana, etc., 45,000 tons. Total, 88.000 tons, against 112,000 tons last year.

CUBA.—The six principal ports: Receipts, none. Exports, none. Stock, none, against 11,000 tons last year. Grinding has ceased.

Stocks in the United States and Cuba together of 122,338 tons, against 121,804 tons last week and 232,020 tons last year, a decrease of 109,682 tons from last year.

EUROPE.—Stock in Europe, 395,000 tons, against 450,000 tons last year.

VISIBLE SUPPLY.—Total stock of Europe and America, 517,338 tons, against 682,020 tons last year at the same uneven dates. The decrease of stock is 164,682 tons, against a decrease of 170,746 last week. Total stocks and afloats together show a visible supply of 610,338 tons, against 799,020 tons last year, or a decrease of 188,682 tons.

Cuba continues to sell new crop sugars for future shipment at prices regardless of the much higher parity of the European market, say for December-January shipment, some 300,000 bags were placed during the week at 2 11-16c., c. & f. (4.05c.), with February-March at 2⅝c., c. & f. Speculators continued to pay better prices than refiners, including sales March at 2 21-32c., c. & f. (4.02c.).

At the close, Cuban sellers are asking 1-16c. advance.

BEET sugar opened the week at 11s. 8¼d. and made a steady rise throughout the week, closing at 12s. 2¼d., equal to 4.58c. for 96 deg. test Centrifugals, a phenomenal advance in a week. The last rise of today is explained by cable as owing to disappointing yield of beet roots and the general statistical position. The mail advices now coming to hand explain the movement as mainly caused by the beet crop estimates put out by the factories, the general disposition of operators being to ignore the much more conservative estimate made by F. O. Licht nearly a month ago and apparently confirmed by him week to week in his repeated cables of favorable weather for the crop. No doubt, however, F. O. Licht is at present paying much attention to the saccharine tests of the roots now being worked, the results of which in his estimation will be given in his revised estimate, now nearly due. It is generally expected that this estimate must necessarily show a reduction from his first estimate, but it is also evident that the speculative movement has gone ahead rather faster than the developments thus far warrant.

From Cuba crop reports continue favorable. Last crop sugars being exhausted, a period of a few weeks exists before supplies from the new crop will be forthcoming, and any change in the weather which should delay the making of the crop would have an important immediate effect upon our market, for our refiners are and will be dependent entirely upon early deliveries to keep their refineries going even at the reduced meltings from week to week.

CUBA CROP.—The amount and disposition of the Cuban crop, as compared with the two preceding campaigns, as of November 9, 1909, is as follows:

	1909	1908	1907
Stock in entire island Jan. 1 of old crop—Tons	None	9,318	None
Estimated crop	1,485,000	961,958	1,427,673
Total supply	1,485,000	971,276	1,427,673
Receipts at United States Four Ports and New Orleans, since beginning of crop	1,431,000	909,276	1,330,673
Estimated afloat to United States	3,000	4,000	4,000
Consumption of Cuba Jan. 1 to date	48,000	45,000	40,000
Export and consumption	1,482,000	958,276	1,374,673
Balance supply, estimated	3,000	13,000	53,000

Estimated stock in island this date	3,000	13,000	53,000
Estimated total visible production to date	1,485,000	961,958	1,427,673
Received in U. S. Four Ports and New Orleans, entire year		911,742	1,349,400
Consumption of Cuba, entire year		62,287	57,471
Stock carried over to next crop		None	9,318

SAN FRANCISCO.—Receipts from January 1 to November 1:

	Tons	
From—	1909.	1908.
Hawaii	175,775	199,456
Philippine Islands	.....	.....
Central America	2,158	1,640
Mexico	3	.....
Peru	1,990	.....
China	326	254
Total	180,252	201,350

LOUISIANA.—The *Louisiana Sugar Planters' Journal* reports that as the grinding season progresses into November, the sucrose quality of the cane, which ran low during October, had increased to normal; but that the tonnage of cane was running from 15 to 25 per cent. short of normal, largely owing to the destruction wrought by the hurricane of September 20th, which broke down an immense amount of cane.

"Rapid progress is being made in grinding the crop and the tonnage continues to prove a distinct disappointment. The cane seems to have made no growth at all since the storm of September 20th and the stalks are lacking in juice and weight. The sucrose content gives no especial cause for complaint, but the continuance of the warm weather is retarding the usual increase which takes place in this usually by the middle of November."

ARGENTINE.—According to the *Board of Trade Journal,* this year's sugar production in the Argentine Republic will in all probability be less than in 1908, although the acreage planted with cane is larger. This is to be attributed to the severe frosts which prevailed in April and May. The forthcoming crop is estimated at 130,000 tons, as against 164,000 tons last year.

The total consumption of the Argentine, as a rule, amounts to 165,000 tons, so that it will be necessary to import 30 to 35,000 tons to make up the shortage.

EUROPEAN BEET SUGAR CROP ESTIMATES.—Below we give the details of the "Factories" estimate of the European Beet Sugar Crop for 1909-10, compared with latest estimate of F. O Licht:

	Factories. 1909-10—Tons	F. O. Licht. 1909-10—Tons
Germany	1,948,540	2,150,000
Austria	1,209,000	1,275,000
France	799,200	810,000
Belgium	242,000	260,000
Holland	181,300	220,000
Russia (1,008,200 tons valued as Refined, valued as Raws would be equal to about)	1,105,200	1,150,000
Other countries	425,670	475,000
Total tons	5,910,970	6,340,000

AUSTRIA, October 27, 1909.—The weight of the roots has improved and the sugar content has increased slightly. The average sugar contents show 15.5 per cent. this year, against the two previous years of 17.5 per cent. and 16.6 per cent. respectively.

HOLLAND, October 27, 1909.—Seasonable weather prevailed this week. Heavy winds prevailed and conditions have been very unpleasant. On one night a heavy freeze occurred. Under these conditions, the farmers fear that they may not be able to deliver all their beets at the factories in good condition, and the work of harvest is therefore being pushed as rapidly as possible. Analyses show 16 per cent. sugar content and 650 gr. weight, against 17 per cent. and 750 gr. weight last year.

FRANCE, October 27, 1909.—The weather this week has been warmer than normal, although the nights are commencing to be quite cool. But little rain has fallen during the week. Under these conditions the roots have improved in weight and the sugar content has also increased, but still continues considerably below last year. The roads have improved and the transportation of the beets to the factories is now going on normally. The latest indications point to a crop about one per cent. larger than last year.

UNITED STATES—BEET SUGAR INDUSTRY—*Weather and Crop.*—During the last week light rains have interfered with the harvest in most beet-growing states and were quite heavy on the California coast. Dry, cool weather is now generally desired.

Ohio.—The weather during the last month has been generally favorable for the beet harvest.

Michigan.—The weather during the week has been moderately cool with numerous scattered showers. Still cooler weather at the close proved most acceptable but dryer conditions are desired from now on. At a recent meeting, the board of directors of the Michigan Sugar Company declared the regular quarterly dividend of 1½ per cent. on the preferred stock.

Wisconsin.—Weather generally mild with declining temperature at the end of the week. Light rain and considerable cloudi-

ness was not entirely favorable. The factory at Madison started up some time ago and is now running smoothly.

Minnesota.—The weather during the last month has been very favorable for the beet harvest and the factory at Chaska is experiencing a most successful campaign.

New Mexico.—Another town in this territory which is becoming actively interested in beet culture is Maxwell, in Colfax County, about fifty miles south of Trinidad, Colorado. Sample beets from nine plots grown near that city during the last summer were recently tested and found to contain from 14.8 to 17.6 per cent. sugar, with an average of 15.7 per cent. This is very gratifying, as the beets were planted late and those growing them had no previous experience. The plants are still in the ground and when the last are harvested they are expected to show even better results. A factory at Maxwell is hoped for.

Colorado.—Weather continues cool and dry; as favorable as possible for the beet harvest. Newspaper reports from all sections indicate that the results being secured by the factories are decidedly disappointing. Tonnage is generally good, but sugar lacking. The factories are generally deluged with beets and are shutting off their deliveries.

Montana.—Cool, generally dry weather with several frosts has favored the beet harvest during the last month. The factory at Billings started the campaign on October 5th with a full supply of beets in the sheds. According to the press there will be a large crop of rich beets and the factory is expected to be kept busy until well into January. Dillon, in the southwestern corner of the State, is reported to be agitating the question of securing a sugar factory.

Utah.—Cooler weather has prevailed during the last two weeks, favoring the work of harvesting the beet crop. Two showers served to loosen the ground, but were not sufficiently heavy to cause much delay.

Nevada.—During the last year the farmers near Fallon, Nev., have been conducting extensive experiments with sugar beets, with the object of securing a factory at the earliest opportunity. Beets recently harvested were tested at the State University at Reno, on October 14th, and showed from 15.5 to 19.9 per cent. sugar, and at a recent mass meeting contracts were signed by those present to grow 7,107 acres of beets if factory was secured. Fallon is located in the Carson Sink country in west central Nevada, near the Southern Pacific main line.

California.—The weather during the greater part of the week was cool and dry. Light rain was, however, experienced in central sections early in the week and general rain at the close. This may interfere considerably with the harvest, although several of

the factories are already through slicing and few have long to run.

The factory at Visalia finished slicing on October 21st, after a run of fifty-two days. The Pacific Sugar Company, which owns this factory, also owns that at Corcoran, and operated them in succession this year. The beets worked at Corcoran are reported to have tested about 18 per cent., but those at Visalia were not quite so rich, owing to the lateness of the season. The character of the roots had also deteriorated considerably, a large proportion being withered and rotted. A substantial increase of acreage is expected in this section next year.

The Spreckels Sugar Co. expects to increase its acreage near King City by 1,000 acres next year. The insect which causes the beet blight which has done much harm throughout the State has been determined and its extermination will probably follow. The Oxnard factory finished slicing on October 29th. On October 30th the Chino factory received 24 cars of beets from Santa Ana.

A record run is being made by the Los Alamitos factory, which is cutting more beets, turning out more sugar, and of a better quality than ever before. It is expected harvesting will continue until about the 20th or the 25th of this month.

EDITORIAL NOTES.

California is having its turn with leaf hopper, not the variety that ravaged Hawaii, but a still more minute species, which has appeared in the sugar beet fields, causing a destructive fungus to attack the beets. The cause of the fungus growth has only just been discovered; and the opinion of the experts is that the pest will be easy to control. The beet people should take no chances in this connection; but seek the parasitic enemies of their particular brand of leaf hopper, forthwith. Hawaii lost about $10,000,000 worth of sugar in about four years, while her entomologists were finding a leaf hopper parasite.

The destruction of cotton by the cotton-boll weevil is causing a large number of farmers in Louisiana to plant other crops. Quite a number are planting sugar cane and selling it to the mills, shipping it in by railroad. Others are raising corn, the 1909 corn crop having amounted to the astonishing value of $30,000,000.

Justice White, of the United States Supreme Court, owns a sugar plantation in Louisiana. The mill was destroyed by fire early this month at a loss considerably in excess of the amount of the insurance, which was for $40,000. The remainder of the crop,

amounting to about 30,000 tons of cane, has been sold to an adjoining plantation, it being too late in the season to restore the mill in time to finish grinding the cane.

The cane borer is reported to be unusually bad this year in the Bayou Lafourche district, in Louisiana. It is said to be second only in its destructiveness to the September hurricane.

The Census Bureau has just issued a bulletin, a resume of which is published elsewhere herewith, giving comparative statistics of lumber production during 1907 and 1908; and showing the steady and rapid increase in prices, with the exception of a slight recession of prices in 1908, owing to the financial depression. The statistics show that the average price for lumber per 1000 feet, at the mill, throughout the United States, was in 1900, $11.13; in 1904, $12.16; in 1906, $16.54; in 1907, $16.56, and in 1908, $15.37.

This is another reminder to users of lumber and timber everywhere, more particularly Hawaiian sugar planters, that one of the greatest of economies that can be practiced, is to plant trees in all available waste places, for fence posts, railroad ties, firewood and hard wood lumber purposes.

STRIPPING VS. NON-STRIPPING.

Sugar planters in Louisiana are still skeptical as to whether irrigation of sugar cane is of any value to supplement inadequate rainfall, when moisture is needed, in spite of the fact that the experiment station under Dr. Stubbs, has established the fact that, properly regulated, irrigation would greatly increase the sugar yield.

This silurian tendency to do things or not to do them, because their fathers have done them, or not done them, is not peculiar to Louisiana planters. We have their counter parts in Hawaii, who keep on stripping cane, at an immense cost of money and men, in spite of demonstration upon demonstration that stripping does no good, and in many cases does positive harm.

We suggest to every plantation manager who is not yet convinced that stripping is an unnecessary expense, that he prove it for himself; not by an experimental plat of a few rows; but by taking a field of several hundred acres; dividing it into alternate ten row strips; strip every other ten rows, and then keep careful statistics of the comparative results—weight of cane, sucrose content of cane, sugar obtained, cost of harvesting, etc., etc. The manager who does this will know what he is talking about. The manager who persists in stripping without a demonstration on his own plantation, on a commercial scale, *may* be right. If he is

wrong, he is incurring a large and unnecessary expense for his company and helping deplete the labor supply. Is it not worth while to find out the truth, by an experiment which will cost almost no money, and but a small amount of gray matter?

THE CHEAPEST HAWAIIAN LIME ON RECORD.

We print else herewith, a communication from a gentleman who is too modest to allow his name to be used, upon the subject of the "Manufacture of Lime from Sand, on Maui." The communication sets forth in terms of great clearness the method of making the cheapest lime ever manufactured in Hawaii, if not in the world.

Lime has been made in a desultory way, for many years, from coral cut from the reefs on the several islands. Some years ago a lime kiln was established near Barber's Point; using the sandstone quarried there. Owing largely to lack of transportation facilities, it was not a success and a kiln was established at Honolulu, the sandstone being brought to town on the Oahu Railway cars. This plant finally fell into the hands of the late S. C. Allen, who spent considerable money trying to supply the island market, but it was not a commercial success.

Another company having secured a limestone quarry in the Waianae district, a couple of years or so ago, erected improved lime kilns, at Honolulu, using crude oil for fuel, and have been successfully making lime ever since. In no instance which the writer knows of has lime been produced, however, at anything like the cost or with such facility as is now being done at Paia, Maui.

The account published herewith shows that two shifts of three men each are producing from 150 to 200 barrels of lime per day, from the sand shoveled up on the beach. The process is simplicity itself. A man shovels up the sand and dumps it into a carrier which drops it into a revolving drum, such as is used for burning cement. There it is subjected to a high degree of heat. It takes forty minutes for it to pass through the drum, when the material which went in sand at one end comes out finished lime at the other; drops into another carrier and is elevated into a bin, from which it is loaded by chutes on to railroad cars.

Although intended originally for fertilizer purposes, the Maui Agricultural Company has for one whole season and part of another, used this lime exclusively, for mill purposes, with entire success.

The demonstration that sea sand can be successfully manufactured into commercial lime with such a simple plant, opens up an entirely new chapter in the history of lime production and use in Hawaii.

There are literally millions of tons of sand now lying idle and available for lime manufacturing purposes, on Maui, Molokai, Oahu and Kauai. The island of Hawaii alone is deficient in coral sand. Most of the plantations on the islands where sand is located own or control ample sand deposits to enable them to make all the lime which they need; and with fuel oil available at from $1.00 to $1.25 a barrel and the extremely simple apparatus demonstrated at Paia to suffice for the purpose, there does not seem to be any reason why lime cannot be privately and profitably manufactured by many of the sugar plantations, for a price not exceeding $5.00 or $6.00 a ton, instead of $15.00 to $20.00 a ton, which is the usual price for the imported article.

It may be found that some sand deposits are not as easily manufactured into lime as is the deposit at Paia, Maui; although the writer of the article in question states that theoretically the Paia lime is not suitable for sugar manufacturing purposes.

It would be an easy matter for anyone desiring to test out the quality of the sand before establishing a plant, to send a few bags full to Paia and secure the burning of it as a test.

In view of the signal success achieved at Paia, it will be sound policy and economy for every plantation possessing a sand deposit to secure, at an early date, an analysis and test of the same with a view to establishing a lime kiln.

THE MANUFACTURE OF LIME FROM SAND, ON MAUI.

Editor Planters' Monthly:—An interesting inovation in lime manufacture has been introduced by the Maui Agricultural Company on their plantation at Paia, and has proven very satisfactory. Their plant has been in operation for a year and a half, and it enjoys the distinction of being the only one of its kind in the world.

The novelty consists not in the lime-kiln so much as in the character of the raw material used, and the methods of handling it. A description of the plant and methods will probably be interesting to the readers of the PLANTERS' MONTHLY. The kiln is of the continuous, rotary type now almost universally used in the States for the burning of Portland Cement. It is a hollow cylinder, fifty feet in length and five feet in diameter, lined inside with asbestos and fire-brick. It is set horizontally, with an inclination of three-fourths of an inch to the foot, rests upon trunions and is revolved by a worm gear.

The raw material is fed into the elevated end of the kiln by a screw conveyor, which is itself supplied by a bucket elevator. The rotation of the kiln, and the inclination at which it is set, causes the material to slowly work its way through the cylinder, whence it emerges in about forty minutes as a well burnt lime.

The lime is taken up by another bucket elevator and is carried into a large storage bin which has a capacity of 1,000 barrels. The bin is situated between two railway switches, and four plantation cars can be loaded with lime simultaneously by simply opening the gates of the bin and allowing the lime to flow into the cars. The fuel used is crude oil, and the burner is placed at the lower or exit end of the kiln, through a stationary circular shield against which the cylinder revolves. This shield is mounted upon a set of trucks and has freedom to move a few inches backward or forward, to allow for the expansion or contraction of the kiln. An electric recording pyrometer is attached, and the temperature of the kiln and of the flue gas is known and is under control.

The daily production of the plant is from one hundred and fifty to two hundred barrels of lime per twenty-four hours, and the entire crew is composed of six men, three on each shift.

One shift comprises an engineer, a man to feed the kiln, and one man in the "quarry." The "quarry" is believed to be an entirely new thing in lime manufacture, for it is the sea-beach upon which the kiln is built, and the "lime-stone" is coral-sand, wet with the spray from the waves which deposited it there.

A light portable track is laid along the beach, a man shovels the sand into a car, pushes it to the kiln, dumps it, and returns for another load. Damp sand is preferred, for the reason that the temperature at which dissociation of carbon dioxide takes place is slightly lessened in the presence of the steam which is generated from the moisture. Many thousands of tons of sand have been removed, but the beach shows very little effect from excavation, being filled in again by the waves as rapidly as it is taken to the kiln.

The company is so fortunate as to have an inexhaustable supply of raw material, daily brought in and placed at the doors of the kiln, without expense. The kiln was originally planned to furnish lime for fertilizing purposes, and the Maui Agricultural Company has made extensive use of it to that end, applying from one to one and a half tons of lime per acre, and has sold large quantities to the neighboring plantations for the same purpose. The granular condition of the lime, i. e., that of sand, renders it ideal for field liming.

It can be applied uniformly, either by hand or by mechanical means, without the necessity of previous slacking; and, applied as quick-lime, is a fungicide as well as a fertilizer. The chemical composition is shown by the following analysis:

Silica Oxide	.29%
Iron and Alumina Oxide	1.09%
Calcium Oxide	91.01%
Magnesium Oxide	5.45%
Sulphur Anhydride	2.06%
Sand and rock	.10%
	100.00%

Chemically, the above analysis would class the lime as meager. Moreover, it is generally considered that over 2.% of Magnesia renders lime unfit for use in clarification, for the reason that it is supposed that the magnesia will increase the encrustations upon the heating surfaces of the evaporating apparatus, rendering the concentration of the juice more difficult and more expensive, and the portion of the magnesia remaining in solution in the molasses would, as an impurity, require more water to hold it in solution and hence produce an increased amount of molasses and a consequent loss of sucrose.

Near the close of the sugar campaign of 1907-08, in July, the kiln was ready for operation, and the last two weeks of the season the "sand-lime" was used in the factory. No untoward results appearing, the lime was used exclusively throughout the season of 1908-09. During this season the mills of the Maui Agricultural Company took off the largest crop in the history of the plantation, and at a speed which taxed to the utmost the capacity of all evaporating apparatus. Not only was the clarification unusually good, but less trouble was experienced with scale in juice heaters, effects, and pans. The molasses loss was not increased, but was on the contrary, very small, despite the fact that 23,000 tons of sugar were made at a polarization of over 99 degrees, and the total crop at an average of 98.34 polarization.

A series of analyses were made of the scales deposited in the juice-heaters, effects, and in the vacuum pans, and also analyses of the mineral ash of the final molasses and of the scum cake. By a comparison of the calcium-magnesium ratio in the lime and in the scales and the ash, it was found that much the greater part of the magnesia had gone out of the factory in the scums. It seems quite possible that the magnesia formed insoluble combinations with some of the juice impurities not attacked by the calcium oxide, thus explaining at once the improved clarification and lack of trouble from the magnesia. The lessened difficulty from scale is attributed to the almost total absence of soluble silica in the lime.

The statement has been made that "it does not pay to monkey with a 90% lime as long as a 98% lime can be had." The statement was evidently made in forgetfulness of the fact that the combining power of the magnesium is greater, weight for weight, than that of calcium, and that according to the above analysis, the lime has a chemical strength equal to 98.64% of calcium oxide, which is a purity rarely exceeded in a commercial lime.

The writer is well aware that some of the results described above are contrary to established theories regarding the action of magnesia in a sugar factory, but is of the opinion that when theory does not coincide with proven fact, it's best to change the theory.

* * *

SUGAR TRUST INDICTMENT DISMISSED—A DECISION WHICH BRINGS CONTEMPT UPON THE LAW.

The United States government has received a setback in one of its numerous indictments against the officials of the Sugar Trust.

One of these cases which was being tried before the United States Circuit Court for the District of New York before Justice Holt, was against Gustav E. Kissel and Thomas B. Harned, who, in conjunction with the American Sugar Refining Company, Washington B. Thomas, its president; Arthur Donner, its treasurer, and John E. Parsons, George H. Frazier, John Mayer and Chas. H. Senff, directors, were indicted for conspiracy in constraint of trade, in attempting to "do up" the Philadelphia Sugar Refinery, by fraudulently getting control thereof and then arbitrarily closing it, thereby ruining its owners and putting a competitor out of business.

The commission of the acts charged to constitute this conspiracy began five years and a half before the indictment was brought.

The acts alleged to constitute the conspiracy continued to be performed up to the time that the indictment was filed.

The defendants plead in bar to the indictment the statute of limitations, which required the bringing of proceedings within three years after the commission of the act complained of.

The contention of the Government was, that the offense of conspiracy was a continuing one, and that the defendants were each day guilty of a fresh act of conspiracy so long as they continued their unlawful acts.

The defendants, on the other hand, claimed that the offense was committed upon the day when the unlawful acts were first performed; that the statute began to run at that date and that after three years from the original act of conspiracy the defendants were exempt from any prosecution.

THE UNJUST DECISION.

Astonishing to relate, Judge Holt has sustained the contention of the defendants and dismissed the indictment.

The judge's reasoning in support of his decision is as follows:

"Statutes of limitation are beneficial statutes. The interests of the community and justice to persons charged with crime require that offenses be promptly prosecuted. Statutes of limitation should be given a plain and sensible construction. The government has waited before bringing this prosecution for five years and a half after the alleged offense was completed, and in my opinion the statute of limitations is a bar to this indictment.

"The authorities upon the law of conspiracy are conflicting. Some hold a conspiracy to be an offense complete when entered

into, upon which the statute of limitations immediately begins to run. Others hold it to be a continuing offense.

"The government's counsel claims that the defendants, having once entered on the conspiracy and closed the refinery of the Pennsylvania company, continued to be engaged in the conspiracy every day, so long as the refinery was closed. It would follow that the only way in which the statute of limitations could be started running would be to rescind the vote to close the refinery, have directors friendly to the American Sugar Company resign and deliver back to the original holders the stock taken as collateral."

THE GOVERNMENT APPEALS.

Immediately upon the deliverance of the opinion, which was on October 27, last, United States Attorney General Wickersham issued a statement to the effect that the Government will at once appeal from Judge Holt's decision.

In an interview upon the subject the Attorney General said: "Where the law says every person who engages in a conspiracy to restrain trade is guilty of a misdemeanor, it means so long as the conspirators are continuing in a course of conduct which restrains interstate trade or commerce, they are violating the act.

"Where the restraint may be terminated by their voluntary act, the statute of limitations does not begin to run in their favor until they perform the act which terminates the restraint, and allow the current of trade, which they had interrupted, to resume its course.

"The government's appeal will be under the act of March 2, 1907. This authorizes such appeal where judgment has been rendered against the government on a special plea in bar, as Judge Holt's decision, according to the Attorney General, is contrary to the views expressed by other judges at circuit, as well as from those entertained by the department of justice."

THE DECISION ILLUSTRATED.

Judge Holt's reasoning is of the specious, technical kind which is evolved to free rich criminals from the consequences of their crimes. It is of that class which both Presidents Roosevelt and Taft have denounced as subtle technicalities, which the courts conjure into the law for the purpose of defeating justice.

Look at the enormity of the situation, if this "Holt made law" is upheld! Certain men enter deliberately into a scheme to violate a law. The violation is not a single act, as though they struck the victim over the head with a bludgeon and killed him outright. It is as though they took a turn around his neck with a rope and each day cinched it up a little tighter, gradually strangling him to

death. They have it in their power to release the victim at any time; but, instead, they each day tighten the rope a little more. Suppose the defendants took five and a half years to complete their plot; is there any one so devoid of logic or justice as to claim that they were not as actively guilty in carrying out their conspiracy on the last day of that term, as on the first? And yet the case under discussion is on all fours with the illustration.

THE TRUST'S STRANGLE HOLD.

The defendants began to carry out their plan of putting the Philadelphia Refinery out of business, on a certain day. They did not set fire to it and burn it up at one fell swoop. That would have been the bludgeon method. Instead, they secured a strangle hold under guise of friendship. They loaned the refinery owners money and took a mortgage, one provision of which was that during the term thereof, the mortgagee should have the nomination of a majority of the Board of Directors. No sooner was the new Board in the saddle, then the strangle program was put into operation. They passed a resolution closing the refinery, and then proceeded to sit tight on the resolution, refusing to rescind it, for five and a half years. Naturally the refinery doing no business, had no income and could not pay interest on the mortgage debt. The interest remaining unpaid, the mortgage remained in force. The mortgage remaining in force the dummy but hostile Board of Directors continued their strangle hold on the victim for five and a half years. They could have rescinded the resolution and ceased their violation of law at any time; but they maintained their murderous clutch on the victim's throat until the Attorney General appeared and tore them off and proceeded to prosecute them for their treacherous work.

THE TRUST IS INNOCENT.

They thereupon assumed an air of virtuous indignation and said: "Why, we have done no wrong! We began to strangle this man five and a half years ago, and the statute of limitations expires in three years; so that for two years and a half we have been choking this man in accordance with law!"

If Judge Holt were presiding at the trial of this case, his decision would be, quoting his own words, as a precedent:

"Statutes of limitation are beneficial statutes. The interests of the community and justice to persons charged with crime require that offenses be promptly prosecuted. . . . The government has waited before bringing this prosecution for five years and a half after the alleged offense was completed, and in my opinion the statute of limitations is a bar to this indictment."

It is such judges as Judge Holt who bring contempt upon the courts. It is such law as this "Holt made law" that breeds lynchings and lawlessness, because the people despair of securing justice through the medium of the courts.

THE NEW 1909 SUGAR TARIFF SCHEDULE.

The following is the full text of the Sugar Schedule of Payne Tariff Act, enacted August 5, 1909:

"Section 216. Sugars not above number sixteen Dutch standard in color, tank bottoms, sirups of cane juice, melada, concentrated melada, concrete and concentrated molasses, testing by the polariscope not above seventy-five degrees, ninety-five one-hundredths of one cent per pound, and for every additional degree shown by the polariscopic test, thirty-five one-hundredths of one cent per pound additional, and fractions of a degree in proportion; and on sugar above number sixteen Dutch standard in color, and on all sugar which has gone through a process of refining, one cent and ninety one-hundredths of one cent per pound; molasses testing not above forty degrees, twenty per centum ad valorem; testing above forty degrees and not above fifty-six degrees, three cents per gallon; testing above fifty-six degrees, six cents per gallon; sugar drainings and sugar sweepings shall be subject to duty as molasses or sugar, as the case may be, according to polariscopic test.

"Section 217. Maple sugar and maple sirup, four cents per pound; glucose or grape sugar, one and one-half cents per pound; sugar cane in its natural state, or unmanufactured, twenty per centum ad valorem.

"Section 218. Saccharine, sixty-five cents per pound.

"Section 219. Sugar candy and all confectionery not specially provided for in this section, valued at fifteen cents per pound or less, and on sugars after being refined, when tinctured, colored or in any way adulterated, four cents per pound and fifteen per centum ad valorem; valued at more than fifteen cents per pound, fifty per centum ad valorem. The weight and the value of the immediate coverings, other than the outer packing case or other coverings, shall be included in the dutiable weight and the value of the merchandise."

THE PHILIPPINE TARIFF SUGAR SCHEDULE.

There has been considerable inquiry as to the exact wording of the portion of the new tariff bill referring to Philippine sugar.

The following is a verbatim quotation from the Payne Tariff Bill of August 5, 1909, in so far as it relates to sugar, it being contained in Section 5 of the Act:

Section 5. That there shall be levied, collected and paid upon all articles coming into the United States from the Philippine Islands the rates of duty which are required to be levied, collected, and paid upon like articles imported from foreign countries:

Provided, that, except as otherwise hereinafter provided, all articles, the growth or product of or manufactured in the Philippine Islands or of the United States, or of both, or which do not contain foreign materials to the value of more than twenty per centum of their total value, upon which no drawback of customs duties has been allowed therein, coming into the United States from the Philippine Islands shall hereafter be admitted free of duty except . . . in any fiscal year, sugar in excess of three hundred thousand gross tons . . . which quantities shall be ascertained by the Secretary of the Treasury under such rules and regulations as he shall prescribe;

And provided further, that sugar, refined or unrefined, . . . imported into the Philippine Islands from foreign countries, shall be dutiable at rates of import duty therein not less than the rates of import duty imposed upon sugar . . . in like forms when imported into the United States:

And provided further, that, under regulations to be prescribed by the Secretary of the Treasury, preference in the right of free entry of sugar to be imported into the United States from the Philippine Islands, shall be given, first, to the producers of less than five hundred gross tons in any fiscal year, then to producers of the lowest output in excess of five hundred tons in any fiscal year. . . .

And provided further, that the free admission, herein provided, of such articles, the growth, product or manufacture of the United States, into the Philippine Islands, or of the growth, product, or manufacture, as hereinbefore defined, of the Philippine Islands into the United States, shall be conditioned upon the direct shipment thereof from the country of origin to the country of destination:

Provided, that direct shipment shall include shipments in bond through foreign territory contiguous to the United States:

And provided further, that all articles, the growth, product, or manufacture, as hereinbefore defined, of the Philippine Islands, admitted into the ports of the United States free of duty under the provisions of this section and shipped as hereinbefore provided from said islands to the United States for use and consumption therein, shall be hereafter exempt from the payment of any export duties imposed in the Philippine Islands.

PHILIPPINE SUGAR TARIFF REGULATIONS.

For purposes of future reference, we publish herewith the regulations issued jointly by the Treasury Department of the United States and the Governor General of the Philippines, providing for the carrying into effect of the new tariff law admitting up to 300,000 tons of Philippine produced sugar per annum, into the United States, free of duty. It will be noticed that practically all

of the regulations refer to the provision giving a preference to the small producer over the large.

The following are the regulations:

"PHILIPPINE ISLANDS—SHIPMENTS OF SUGAR, CERTIFICATES OF ORIGIN.

"[Circular No. 57.]

"Treasury Department, November 1, 1909.

"To Officers of Customs and others concerned:

"The accompanying executive order promulgated by the Acting Governor General of the Philippine Islands, under date of October 22, 1909, carrying into effect the provisions of section 5 of the tariff act of August 5, 1909, so far as they relate to the issuance of certificates of origin for products of the said islands shipped to the United States under Circular No. 37 of August 10, 1909 (T. D. 29944), is hereby published for the information of all concerned.

"The provisions made in this order for keeping proper records of the production of sugar meet with the approval of this Department and should be considered as supplemental to said Circular 37.

"CHARLES D. NORTON,
"Acting Secretary."

"EXECUTIVE ORDER.

"Office of the Governor General,
"Manila, October 22, 1909.

"Whereas coöperative action on the part of the Philippine government appears desirable for the proper and practical enforcement of those provisions of section 5 of the United States tariff act of August 5, 1909, relating to the limitations and qualifications placed upon the free admission into the United States of Philippine sugar, tobacco and cigars, the following regulations are, by arrangement between the honorable Secretary of the Treasury and the honorable Secretary of War of the United States, promulgated in that behalf for the information and guidance of all concerned:

PRODUCERS MUST FILE APPLICATIONS.

"Paragraph 1. All producers of sugar desiring to avail themselves of the privileges of free entry of sugar into the United States, either directly or indirectly, shall file with the collector of internal revenue, in such form and manner as said collector shall prescribe, written applications therefor before the opening of the shipping season and not later than the first day of November in each year. Each such application shall contain a statement, under oath, of the applicant, setting forth the quantity of sugar produced, or proposed to be produced, by such applicant during the fiscal year in which the application is made; the place and manner of production; the area of land employed, or to be em-

ployed, by such applicant, if any; its location; the quantity of sugar for which the applicant desires free entry and will ship, or intends to ship or sell for shipment to the United States; that said sugar has been or will be actually produced by said applicant, and such other data as may, from time to time, be required by the collector of internal revenue.

DEFINITION OF "PRODUCERS OF SUGAR."

"Paragraph 2. The term 'producers of sugar,' as used in section 5 of the United States tariff act of August 5, 1909, and for the purpose of these regulations, shall be taken to mean individuals, firms, or corporations who actually produce, or procure the production, from materials owned by them, of sugar in its first marketable form as such, and are owners thereof when it reaches that stage of advancement.

COLLECTOR TO INVESTIGATE TO PREVENT FRAUD.

"Paragraph 3. The collector of internal revenue shall establish registers and record therein all applications filed in pursuance of paragraph one hereof, and all changes of ownership of each lot of sugar covered thereby concerning which satisfactory evidence of such change of ownership is produced to him. He shall investigate all statements of applicants and others involved in such manner as may be necessary to prevent any infraction of the law or fraudulent practice with reference thereto.

REGISTER OF PRODUCERS OF LESS THAN 500 TONS.

"Not later than November 20th of each year the collector of internal revenue shall transmit to the insular collector of customs complete transcripts of the registers herein prescribed, with full information pertaining to each entry therein, showing the owners of record at the date of transmittal, and so arranged as to show in one group the producers, or intending producers, of less than five hundred tons of sugar, and in another group, in progressive order, by quantities, those who have produced, or intend to produce, five hundred tons or more, within the fiscal year for which their application for free admission into the United States is filed. Thereafter he shall promptly inform the insular collector of customs of all changes in ownership of which he may be satisfactorily advised. The collector of internal revenue shall also furnish the insular collector of customs, upon request and as required by the latter, with all information in his possession or that may be acquired by his bureau, which will enable the latter to determine the correctness or incorrectness of 'exporters'' (shippers') statements in connection with the certificates of origin required by U. S. Treasury Department Circular No. 37, series of 1909.

CERTIFICATES OF ORIGIN TO BE ISSUED.

"Paragraph 4. The insular collector of customs is hereby charged with the duty of causing to be issued at the various ports of entry in the Philippine Islands, under proper regulations, in strict accordance with the facts and the terms and spirit of section 5 of the United States tariff act of August 5, 1909, and U. S. Treasury Department Circular No. 37, series of 1909, the certificates of origin prescribed in said circular. He will take the necessary measures to prevent the issuance of such certificates of origin in any fiscal year covering sugar, cigars, or tobacco in excess of the quantities of those commodities entitled to free entry into the United States in any fiscal year under the provisions of section 5 of the United States tariff act of August 5, 1909.

PREFERENCE TO PRODUCERS OF LESS THAN 500 TONS, EMPHASIZED.

"The insular collector of customs shall cause certificates of origin covering sugar shipped to the United States to be issued in such manner as to give full effect to the provision of section 5 of the United States tariff act of August 5, 1909, requiring that 'preference in the right of free entry of sugar to be imported into the United States from the Philippine Islands * * * shall be given, first, to producers of less than five hundred gross tons in any fiscal year; then to producers of the lowest output in excess of five hundred tons in any fiscal year,' using as a basis for the arrangement of the issuance of such certificates the registers furnished him by the collector of internal revenue as required in paragraph three hereof:

"*Provided, however,* That custom officers issuing such certificates shall themselves individually use every precaution to prevent any perversion of the provisions of the law herein quoted.

"The insular collector of customs shall not issue or permit to be issued any certificate of origin until he or such issuing officer shall be personally satisfied from such investigations as may be necessary (1) that the certificates of origin issued by them do not cover merchandise in excess of the limitations prescribed in section 5 of the United States tariff act of August 5, 1909; (2) that the statements of the 'exporter' (shipper) are correct and that no part or parcel of the merchandise described therein contains foreign materials to the value of more than twenty per cent. of the total value of any completed article described in any such certificate; (3) with respect to sugar that the issuance by them of such certificate of origin covering that product will give full effect to the provisions of section 5 of the United States tariff act of August 5, 1909, relating to the preference to be given to the smaller producers of sugar in their right to free admission of their product into the United States.

ADVISE TO SMALL PRODUCERS.

"Paragraph 5. It is hereby made the duty of all officials of the Philippine government who are required to perform acts in con-

nection with the carrying into effect of the terms of this order to instruct and advise small producers of sugar of their preferred rights in the premises.

"Paragraph 6. Copies of this order shall be distributed by the collector of internal revenue to all producers of sugar and to all cigar and other manufacturers in the Philippine Islands, as well as to all other persons interested or concerned.

"W. CAMERON FORBES,
"Acting Governor General."

EFFECT OF THE PHILIPPINE SUGAR TARIFF.

In our June number we gave a forecast of the effect, on the sugar production of the world, of the new policy of the United States in admitting sugar from the Philippines free of duty. The quantity, it is true, is limited to 300,000 tons, but that is a larger quantity than has ever been produced in those islands. We naturally regarded this policy as a distinct invitation to capitalists to exploit those fertile and well-favored Colonies and enjoy the handsome preference of 6s. 3d. per cwt. But since the publication of that article the United States Senate have made an important amendment in the Tariff Bill, which has now become law. For the express purpose of preventing any such exploitation it is now enacted that the 300,000 tons of free sugar are to come from the existing native sugar planters of the islands, and no new comer is to enjoy the privilege unless supplies from the native planter are exhausted before the fixed quantity is reached. This arrangement entirely alters the aspect of affairs. The United States Senate foresaw the effect which we endeavored to describe and evidently did not approve of the prospect that a preference conferred for the special purpose of benefiting the Philippinos should be snatched from them by capitalists from outside. It remains to be seen how the system will work and what will be the result of their vital modification of the original clause in the Tariff Bill. —*International Sugar Journal.*

THE JOKER IN THE PHILIPPINE SUGAR SCHEDULE.

We publish herewith the portion of the Payne tariff bill, which deals with the Philippine sugar schedule, and also the regulations which have been issued by the United States Treasury and the Governor of the Philippines, relating to the enforcement of the same; also an article commenting on the effect of the bill from the *Inter-National Sugar Journal.*

As is well known, the proposition to admit raw sugar from the Philippines into the United States, free of duty, has given great concern to the sugar world; not only to the American sugar producers and those already having free access to the United States

market; but to the sugar industry at large, as the possibilities of immense production in the Philippines are so great that a free market was liable to so stimulate production as to prove a disturbing factor in the entire sugar business of the world.

When the announcement was made that the bill as passed limited free entry of sugar from the Philippines to the United States to three hundred thousand tons per annum, there was a feeling that it was only less dangerous than would have been free entry for the entire product of the Islands. It still contained a menace, for the addition of even three hundred thousand tons to the world's supply, from a new source, and its substitution for a like amount of sugar heretofore derived from other sources, was still liable to seriously disturb the trade.

A provision in the bill which at first did not attract much attention, has, however, entirely changed the situation.

The provision is to the effect that producers of less than 500 tons each, shall have priority of access to the free market in the United States, over those producing over 500 tons each; and further that of those producing more than 500 tons each, those producing the smallest amount shall have preference over those producing a larger amount.

Whether this unusual provision was evolved by President Taft, who is known to be strongly opposed to the large plantation system, in the interest of the small Philippine producer, whom he has shown himself anxious to safeguard; or, whether it was invented by the American sugar producers with a view to minimizing the output from the Philippines, the result will be the same, viz: it will discourage, if not almost entirely prevent, the investment of any large amount of capital in the production of sugar in the Philippines.

The reason for this indirect result is that the overwhelming proportion of sugar now manufactured in the Philippines is made in little mills producing from less than a hundred to a few hundred tons of sugar. Many of the mills consist of three upright wooden rollers, which are revolved by a carribou hitched to the end of a pole, the sugar cane being fed into the rolls by a man who holds an armful of cane and feeds it into the mill one stick at a time. The resulting juice is boiled down in kerosene tins or little try-pots not very much larger. Every one of these producers will have a free market open to him, and this fact will probably multiply the number of little mills, without the total amount produced, however, amounting to more than enough for local and nearby demands for some time to come. Such plants, or even mills considerably more efficient than those above mentioned, will have no attraction for capitalists, such as has been presented in the Cuban and Porto Rican fields, where modern methods and modern machinery have revolutionized the industry within the last ten years.

A capitalist, who, but for this provision in the law, might be prepared to invest millions in developing the rich lands of the

Philippines, will be slow about investing when he knows that he is liable to have his sugar shut out from the United States by the multiplication of the small producers. It is not a case of "first come, first served;" but a case of the small man first and the big corporation nowhere.

There does not seem to be any escape from the conclusion that, until there is some amendment to the Philippine sugar schedule, there will be no large investment of capital in the sugar industry in those islands, and consequently no rapid development of the business.

CONCLUDING REPORT ON TRAVELS IN THE MALAY ARCHIPELAGO IN SEARCH OF PARASITES FOR THE CANE BORER.

By F. Muir.

The Hawaiian Planters' Record.]

My last report, written in the quarantine shed at Port Moresby, covered my landing. After five days detention, I was allowed out of quarantine and moved down to the Port Moresby Hotel. I took the first opportunity to call upon Mr. M. Staniforth Smith, administrator and chief of the agricultural and mining bureaus, from whom I received a great deal of useful information as to the best districts to visit for sugar cane, also offers of help in every way possible. A couple of days later I was introduced to Mr. F. Rattle, an Englishman, who is experimeting with cotton growing, in the Laloki district, about fifteen miles from Port Moresby; he offered to put me up for as long as I liked to stay, and as his camp was the nearest place to Port Moresby, where I could get a fair amount of sugar cane, I gladly accepted his offer, and arranged to go out to his camp as soon as he returned from inspecting some land along the east coast. I soon found out that it was no easy task to move about in this district, unless one had "signed on" some natives, for although there were many "boys" about Port Moresby doing nothing, yet I could get no one to carry my bags, even the short distance I was going. Eventually, I was indebted to the representative of Messrs. Burns Philp & Company for the loan of half a dozen "boys" to carry my bags with cloths and a certain amount of tinned meats, etc., that it is necessary for one to take.

The road, after skirting the coast for a short distance, turns off over the low coast hills and, with many a turn and rise and fall, through a comparatively uninteresting country, strikes the Laloki river about twelve miles inland. The coast hills consist of metamorphosed limestone, and the same formation crops out all over the country up to the Astrolabe mountains at the back, an igneous formation that evidently caused the metamorphosis of the lime-

stone. Among the outcrops are flats of greater or lesser size, of deep dark loam of a fine mechanical texture, covered with long grass, which thins out on the limestone outcrops. A stunted species of "blue gum" is scattered over the country, and a cycad is conspicuous, especially on the limestone outcrops. Until one reaches the river, where there is some large timber, the road is monotonous and hot, especially if it be necessary to walk it twice a month or so for one's mail.

As Mr. Rattle's camp is situated in the fork of the Laioki and Goldie rivers, it was necessary for me to cross over the Laloki. At present bridges in this part of the world are left to nature to construct, and generally consist of one or more large trees, washed down by the floods, getting stranded across the river. Such bridges are naturally as quickly swept away as formed, and it often happens that when you want to go into port, or get back home, you must search for miles along the bank for a bridge; also such bridges are not always the most convenient to cross, and I sometimes preferred to cross on the seat of my trousers rather than on the soles of my boots. Crocodiles are numerous in the rivers, although one seldom sees them, as their movements in the water are so noiseless for such a large and clumsy-looking animal; a twelve-foot beast will glide off a log into the water leaving hardly a ripple on the surface.

The road being unknown to me, I missed the path through the timber down to the river, and so did not reach camp until near midday.

Soon after our lunch my boat took me to the native gardens in this vicinity; and before we had been there half an hour, I discovered the cocoon of our sugar cane borer, containing the puparia of the Tachinid parasite. Such quick success to my search delighted me, as I had not expected it, and immediately explained to my host how convenient to me it would be if I imposed upon his hospitality for a few months. He considerately tried to put the glove on the other hand, by insisting that my company would be very acceptable, as he was tired of having no white man to speak to for weeks at a time. A few days later, I returned to port, cabled to Honolulu to inform the Station of the satisfactory conditions and to take back some cages, bottles, etc., for breeding purposes. Again I was indebted to Messrs. Burns Philp & Company's representative for the use of "boys" to carry my boxes.

Mr. Rattle's house was a temporary one-roomed, native-built grass affair, to be substituted by a more permanent abode if his cotton experiments proved a success, and its cultivation taken up extensively. Along one side of the room was a raised platform on which we placed our camp-beds; a small camp table and chairs were the chief items of furniture. With a few billy-cans, a camp-over, etc., one can be very comfortable, for the bush, but scientific work is restricted. For the first month we were fairly well off, as his house-boy was a good one, for a Papuan, but when his time was up we could not get another, and so had to do our own cook-

ing and washing. This is the common thing in the New Guinea bush.

Situated between two rivers, with a swamp at the back, mosquitoes were naturally very numerous; at sunset a wood fire was lighted in the center of the room, and we turned into bed very early. In the immediate foreground, looking from the camp toward the north, was the heavily timbered banks of the river, and beyond that one could see Mount Victoria (13,000 feet) and other peaks of the Owen Stanley range; to the east, about ten miles off, rose Homblom Bluff, about 2500 feet, and a little to the south Waiarata, about 3000 feet. In the other directions our view was blocked by the timbered banks of the river.

All this district (about 30 miles on each side of Port Moresby and extending about 20 miles inland) is the "dry belt" and, for New Guinea, has a very small rainfall. All the native gardens near our camp were from 40 to 100 yards wide, extending to various lengths along the river banks. The native trees are cut down and partly burnt, various native products, such as bananas, taro, yams, sugar cane, pumpkins and pineapples, are planted haphazard and grow at their own sweet will, which is very luxuriantly about here, as the soil is a deep, rich, river deposit. Women do most of the work in the gardens. These gardens, especially among the pumpkins, were favorite places for snakes, a large poisonous species, locally known as the "black snake" being very numerous. One I shot was over five feet long, and I saw others much larger.

The natives all through Papua grow sugar cane in their gardens, which they eat, but never make into sugar, nor do they use the sugar palm for this purpose in the districts I visited. The roots are ratooned several times and "tops" planted in patches and grow to large size. It would soon fall down and break if they did not tie it into bundles and support it by a large stick.

These large bundles of cane, dead leaves, etc., form ideal breeding places for various insects, partly secure from some of their natural enemies. The sugar cane was badly bored, but the worst pest was not our beetle borer (*Sphenophorus obscurus*), but a species of moth, nearly allied to the Striped Stemborer (*Diatraea striatalis*) of Java. There is a parasite on its eggs and a Tachinid parasite on the larva, but the latter is so heavily parasitized by a small wasp that I failed to breed any out. The second borer in importance is a small beetle (at present unidentified) that works in a similar manner to our Hawaiian beetle borer. To one used to the conditions of the borer in Hawaiian and Fijian sugar cane fields, the borer in Papua is not numerous, a day's search seldom revealing more than a score, and traps of cut cane laid down over night produced very few.

Where the borer is breeding in the sugar cane tied up into bundles, I found out of 300 cocoons 56% parasitized, but where the borer is breeding in upright single stalks the percentage, out of 200 cocoons, rose to 87%; this latter would be more the con-

ditions the parasite would have to work under in our Hawaiian fields. These figures only represent the conditions existing in the district where I was located and during the three months I remained there; elsewhere and at other seasons of the year, they may vary very considerably.

In these matters it is always safest to be a prophet after the event, therefore I am loath to make any definite statement as to the value of this parasite when once established in these islands. In Amboina and Ceram it exists under very moist conditions in the borer larva living in sago; while in the part of Papua I worked in it exists under comparatively dry conditions in borer larva living in sugar cane. This indicates that it is very adaptable, both to habitats and climatic conditions, and should be well able to adapt itself of the conditions prevailing in our islands.

The difficulty is to get these small flies from such a distance, the shipping facilities being very poor, and great delay in transshipment being unavoidable. The best route is from Papua to Brisbane, and then by the Vancouver boat to Honolulu, but the difficulty is to avoid delay along the Queensland coast.

The method I decided upon was as follows: First, to get large colonies of borers established in healthy cane stems in the fields, then to expose them to the attacks of the parasites under natural conditions, and then transfer root and stems to my cages and bring them back. By having a stock of unparasitized borer on hand I hoped to be able to get a second generation en route should the first hatch out before I reached Honolulu.

To avoid delay I chartered a small sailing boat to take me across to Cooktown (Queensland) where I could pick up the coast boat to Brisbane. Unfortunately this arrangement fell through and I had to go across to Thursday Island and from there to Brisbane. Bad luck overtook me and before leaving Port Moresby I contracted typhoid fever, which compelled me to call in a doctor upon reaching Brisbane; he immediately sent me into a hospital where I remained for over five weeks. My cages were landed and placed in the government railway shed at the docks, by permission of the Queensland Agricultural Department, and would have had to remain there had not Mr. Claud Musson, a gentleman in Brisbane, to whom I carried letters of introduction from Port Moresby, kindly looked after the shipping of them by the S. S. Aorangi.

Having no one to attend to them during the voyage, it was to be expected that no, or very few, parasites would arrive alive. Mr. Swezey, who handled my cages upon their arrival, informs me that over two hundred parasites must have hatched out and died en route. With the experience now gained, I think we shall succeed upon my return to Papua.

In my report upon my return from Fiji in 1906 I wrote: "It is interesting to note that with the reintroduction of soft varieties of cane" (Guru and Badilla from Queensland), "the borer is apparently on the increase, or at least its attacks are more severe." At

that time these two soft varieties were only being grown on a very small scale. When passing through Suva on my way from Brisbane, I learnt that one had entirely gone out of cultivation owing to disease, and the other was so very severely attacked by borers that a fairly heavy wind would sometimes bring down whole fields; the continuation of its cultivation was very doubtful.

One of the most interesting things about the native sugar cane in Papua is the great number of varieties that exist. Nearly two hundred have already been collected and planted in the government gardens and more are constantly being sent from the various districts. The reason for this great number, I believe, lies in the fact that in Papua the canes seed abundantly and sow their own seed; on several occasions I found seedlings growing in the gardens. When one considers that often, off of one arrow, many vareities can be reared, it is only reasonable to suppose that in a country favorable to the natural sowing and germination of the seeds, an infinite number of varieties could be found. Many of these varieties must have been established for many years, as the natives recognize them and have given them distinct names. Several very good varieties have been introduced into Queensland and Fiji, but many, possessing various qualities that would be useful for crossing purposes, must still be unknown.

A leaf-hopper (*Perkinsiella vastatrix*) allied to our Hawaiian species is found in the sugar cane, but its numbers are kept down by parasites in the eggs, very similar to those imported into Honolulu from Queensland and Fiji. Another small light colored hopper is also found in all its stages on sugar cane, its numbers being kept in check by similar death factors.

When I consider the numerous species of insects that I have found living on sugar cane in the various places I have visited during the last three years, some belonging to groups of which we are quite free at present, any one of which might prove as destructive as the leaf-hopper or beetle borer, I then fully recognize the necessity of keeping the strictest supervision over all imported plants and fruits.

Queensland sugar planters have introduced the Hawaiian beetle borer (*Sphenophorus obscurus*) into their fields along with New Guinea sugar cane. At present it is only in the Mossman district, and they are making efforts to stamp it out, but I doubt if they will succeed.

At present there is a big boom in British New Guinea (known officially as Papua) several large English and Australian syndicates having taken up land for tropical agricultural purposes.

The sea-island cotton, growing at Mr. Rattle's place on the Laloki, was the largest and finest I have ever seen; the bushes, although cut back when about five feet high, were eight and nine feet high, covered five or six square yards and were covered with fine large bolls when I left. Two species of cotton stainer were the worst enemies on it; the cotton boll-worm (*Heliothis armigera*) is scarce, only appearing in an odd boll or two; evidently

it is kept in check by some efficient enemy, but the only one that I noticed was a wasp which would carry them off for food for its young.

Tobacco grows wild in the native gardens, the leaf often being of good size and free from spots; under proper cultivation no doubt it would do as well as in Sumatra. Para rubber and a native Ficus do well; the former is being planted on several new plantations. Sisal hemp is also being planted extensively and does well.

Land can be leased on easy condition from the government and to a limited extent the country is sure to go ahead, but the scarcity and quality of the labor prevents it from ever becoming a second Java.

Copper has been found over a large area of the Astrolabe range, but little has been done at present to develop it. Several persons have shipped surface ore and developed far enough to prove their propositions, but have not sufficient capital to continue.

THE JAMAICA EXPERIMENT WITH B. 208.

There is published herewith the results of a seedling cane experiment in Jamaica, which shows a surprisingly high yield for a Barbados cane, number 208. In a number of tests, in comparison with the White Transparent, the usual cane in Jamaica, the following results were obtained, no fertilizer being used, viz:

1. Both fields of first ratoons:
   B. 208, yield 35.1 tons cane per acre.
   White Transparent, yield 21 tons cane per acre.
   Superiority of B. 208, 66 per cent.
2. Both fields of third ratoons:
   B. 208, yield 50.9 tons of cane per acre.
   White Transparent, yield 34.8 tons of cane per acre.
   Superiority of B. 208, 46 per cent.
3. Both fields of first ratoons:
   B. 208, yield 47.5 tons of cane per acre.
   White Transparent, yield 23.2 tons of cane per acre.
   Superiority of B. 208, over 100 per cent.

A cane which will beat the local cane by from 46 to over 100 per cent., is worth taking notice of under any conditions; but when the report shows that in Jamaica, an island of low yields, as compared with Hawaii, a yield of over 50 tons of cane per acre is obtained, without fertilization or irrigation, it is doubly of interest.

The *Planters' Monthly* is informed by Mr. Noël Deerr, that B. 208 has been tried by the Hawaiian Sugar Planters' Association station at Honolulu and all of its sub-stations on the various islands, with the surprising results that it has proven to be one of the poorest seedling canes tried in Hawaii. Similar results have been obtained in some of the other West India Islands. This is probably accounted for by the difference in climatic and soil conditions.

The moral to be drawn from this is that Hawaii must work out its own salvation in the way of developing new and valuable variety of canes.

This does not mean that we should not continue to try out all of the high grade canes evolved by other experiment stations; but that good results elsewhere are no sure criterion of what may be obtained here. The fact, however, that such radical improvement elsewhere is obtained through the medium of seedling evolution should more than ever encourage us to continue local efforts to produce new and better canes.

It is suggested that the importance of the question is so great that the Hawaiian Sugar Planters' Association would be warranted in increasing the scope of its operations in connection with the production of new canes. An increase of one per cent. in the available sucrose in a given cane, would be the equivalent of an increase of seven or eight per cent. in profits. Beets have, by seed breeding, increased in a hundred years, from an average sucrose content of four or five per cent. to 14 to 16 per cent. and even better.

SOME RECENT RESULTS OF EXPERIMENTS WITH SEEDLING CANES IN JAMAICA.

By P. W. Murray.

It may be of interest to sugar planters and others to have a short account of the results which have recently been obtained from experiments conducted at Stevens Estate in Clarendon, Jamaica, with some of the imported seedling canes from Barbados, as compared with the White Transparent, which is the local cane usually grown on the estates of the island. Canes for the experiments were selected from three distinct fields in different sections of the estate, and the results may be considered a fair average for the estate and for places similarly located in the island. The soils of this estate are of a rich alluvial character, containing a high percentage of sand, which allows of excellent drainage into the river bed which adjoins the fields. These particular fields are flooded during the heavy rains, and receive a rich deposit of sediment which is largely responsible for the excellent crops that these fields yield without the application of manures.

In the first field cut, Breadfruit Piece by name, there were two varieties tested—B. 208 and the Estate cane. This was a field of first ratoons, and the varieties were planted together, there being 2500 stools to the acre. One hundred stools of each were carefully cut and weighed, with the result that B. 208 gave 35.1 tons, and the Estate cane 21 tons of cane per acre. This represents a gain of 66 per cent. by B. 208. In the second field, "Nursery Piece," which is a field of third ratoons, three varieties were tested, B. 208, the Estate cane, and B. 147. The variety B. 208

gave 50.9 tons, the Estate cane 34.8 tons, and B. 147 gave 30.3 tons per acre. This represents a gain of 46 per cent. by B. 208 over the Estate cane, whilst B. 147 fell below the yield of the Estate cane. In the third field, "Bangor Piece," of 1st ratoons, B. 208 gave 47.5 tons, and the Estate cane 23.2 tons per acre, which represents a gain of slightly over 100 per cent.

These results are particularly interesting as they were all obtained from ratoon canes, which is a very important point to many sugar planters. In many instances the results secured have been even more satisfactory than the above figures.

As I am often asked how the cane seedling is raised from the seed, I give a short summary of the methods employed in the different stages:

1. The parent or seed-producer is carefully selected and seed gathered from the arrow when ripe.

2. About 30,000 seeds in number are sown in boxes of sand under glass, and the seedlings allowed to grow until about four inches high.

3. Of these, the more vigorous are selected and transferred to bamboo pots, which selection reduces them to about 80 per cent.

4. After they have grown in these pots to a height of two feet, the best are again selected, and about 2000 of the original 30,000 planted in the field,

5. Of these 2000, about 50 of the best, after they have developed into full-grown canes, are selected and planted in rows.

6. The canes of the 50 stools are cut when ripe, carefully weighed and ground, and a sample of the juice taken. The sucrose content per acre is then calculated; and the canes are now classified according to their sugar-yield per acre.

7. The finest of these are planted in 100-stool lots, and treated as in the previous paragraph. All the canes that prove to be equal in quality to, or surpass the canes generally established in the island, are kept for further trial, and the remainder discarded.

8. The canes which are kept are then treated as ratoons, and only such as possess good ratooning qualities are grown for distribution to the estates.

It will readily be seen that the above method, which covers a period of six to eight years, gives a reliable test of the field qualities and sucrose yield that may be expected from the canes finally selected.—*Bulletin of the Department of Agriculture, Jamaica.*

CANE BORERS IN LOUISIANA.

Cane borers in Louisiana appear to be fully as destructive as they are in Hawaii. The last number of the *Louisiana Planter,* in commenting upon the subject, says:

We do not think that our national entomologists have attached enough importance to the cane-borer as a damager of crops in the sugar region of Louisiana. There is no compensating balance in

that insects work whereby in the cutting off of one-tenth of a crop he makes the remaining nine-tenths sell for more than the ten-tenths would have sold without him.

The injury that the cane-borer does in this State is a dead loss without any subsequent compensation. Its damage is not confined only to the destruction of a given percentage of the crop attacked, but it increases the cost of manufacture by making the work more difficult and very often more disastrous to the milling machinery mainly employed in its accomplishment.

The cane-borer appears to be more than usually evident in our sugar region this year. The *Louisiana Planter* has already explained how it has very materially added to the storm damage this year by rendering the popular and most valuable cane most susceptible to its attack, more brittle and consequently more liable to wind-breakage.

Take the Lower Coast for instance, where the storm-damage was probably proportionately less than in most parts of the sugar region. Perhaps three-fourths of the wind breakage was due to previous borer perforations of the stalks affected; or where the wind breakage amounted to 20 per cent. it would not have reached more than 15 per cent. had not borers previously weakened the stalks at the point of fracture.

Those most familiar with sugar manufacture know that every joint of sugar cane perforated and fed upon by cane-borers is comparatively valueless for the amount of juice it contains. Its sugar producing capacity is lost; but not only that, the grinding of great numbers of such joints keeps a mill from shutting down close enough to obtain the maximum possible extraction from the unaffected joints and stalks ground with the borer cane. And last and perhaps not least the machine breakage due to handling heavy tonnages of borer cane has entailed heavy expense in every part and parish of our sugar region.

Perhaps the present borer evil could be minimized by having the trash on every sugar plantation after the rolling season, raked up on the top of the cane furrow and burnt in dry weather on each plantation all on the same day. The present plan of leaving the trash in the cart furrow to be run over by the loaded wagons and mashed into the ground, then left there to escape the general trash burning is probably largely accountable for the great increase of the cane-borers.

The entomological bureau of the National Department of Agriculture has already paid passing notice to the cane-borers in Louisiana; and nearly 30 years since its present head, the distinguished Dr. T. O. Howard, was sent to the Lower Coast of this State in the early spring to study the borer larvae on their native heath. Careful, complete burning of all cane trash in the fields and around the factories was his chief recommendation for keeping down these damaging insects and their depredations.

That was away back in 1880. Since that ancient era entomology has made marvelous advances, or the scientists following it

have progressed very far. It has been found that corn and other crops, and wild marsh grasses harbored cane-borers as well as did sugar-cane. That knowledge showed that borer destruction was a very much more difficult problem than it had been deemed.

In view of the magnitude of this insect plague in our State it would be very interesting to the U. S. Department of Agriculture and to the Louisiana sugar planters to start a renaissance of the cane-borer studies.

Perhaps if one-tenth of the activity displayed in boll-weevil investigation and the discovery of means of extermination were officially applied to the very worst insect foe of our sugar-fields the cane-borer pest in this State might be largely abated, or the species be completely destroyed by the application of up-to-date scientific means.

Secretary Wilson and his chief entomologist, Dr. Howard, would be given a mighty good time if they would only come down to the Louisiana lowlands on a cane-borer hunt this winter.

HOW TO GET RID OF CANE BORER.

The last number of the *Louisiana Planter* states that the cane borer is the most destructive cane pest in the State. It thereupon bemoans the fact that nothing is being done to reduce its ravages, and suggests that the National Bureau of Entomology come to the rescue.

If the Washington powers that be are ready to respond, well and good; but the *Planter* itself states that they have been looking into the subject since 30 years ago with no results except a recommendation to burn off the fields.

We suggest that the Louisiana planters follow the example of their brethren in Hawaii and get busy themselves without waiting for the government to come along and do the work for them.

Hawaii has for three years past been employing an entomologist to hunt for and bring to Hawaii, insect parasites of the cane borer. The story of his wanderings and adventures reads like an Arabian Night's Fairy Tale. The last chapter is published herewith. The parasites have failed to reach Hawaii alive, through no fault of Mr. Muir. The salient fact remains that he has discovered the borer in its native lair, and identified the parasites which prey upon it.

Mr. Muir will soon take up the quest once more, and we have faith that he will eventually be successful and score one more victory for practical entomology, by "fighting bug with bug."

NECESSITY FOR STRICTER INSECT QUARANTINE.

It is reported that the Philippines have had, and are having, a plague of locusts, which has seriously interfered with the sugar industry and a low yield is expected in consequence. Hawaii has had its share of insect pests; but locusts have never bothered the

planters here and with a close entomological quarantine, there is no reason why they ever should. The fact, however, that territory with which Hawaii is in frequent direct communication, is now suffering severely from insects preying upon sugar cane, is sufficient to more than ever put us on our guard against their introduction into Hawaii. Practically all of the insect pests from which we now suffer have come from abroad, and would not have come to Hawaii if an efficient insect quarantine service had been maintained at Honolulu. An inspection service is now established, which is good as far as it goes; but it is not perfect, for two reasons, viz:

Fruit, seeds, cuttings and plants are continually being brought into the Territory in baggage or through the mails, which escape the inspector's eye. This happens largely through inadvertance or carelessness; but a leaf-hopper which came into Hawaii through carelessness destroyed just as much cane as one which was introduced through "malice aforethought."

The remedy is to constantly repeat and re-repeat the statement that the common good absolutely requires that every vegetable substance which can harbor insect life should be voluntarily submitted to the entomological inspector for examination before it is brought into Hawaii; and enforce the law which requires this to be done.

Another source of danger is plants which are submitted to inspection; given a dose of gas or other germicide and admitted to the Territory by the inspector.

The disinfection given is better than nothing; but it is a well known fact that insects frequently survive treatment which, theoretically, should kill them.

In view of the millions of dollars which have been lost to Hawaii through the depredations of insects, which might and could have been excluded, the *Planters' Monthly* urges that plants which are treated and admitted should not be immediately delivered to the owners; but should be held for a probationary period, and re-examined from time to time, until it is established to a certainty, that they no longer shelter insect pests. This would require the construction of several wire netting shelters, to prevent the escape of insects pending final examination, and would require the employment of an additional laborer or so to tend the plants while they are in quarantine; but this expense is a bagatelle compared to the cost saving if only one destructive fly or betel is excluded, which otherwise would enter the Territory.

It is conservatively estimated that the leaf-hopper caused a loss of $10,000,000 worth of sugar in Hawaii, in less than six years. This amount would have provided a score of inspectors at high salaries, with gold plated and inlaid inspecting sheds covering acres of ground, for the next century, with enough money left over to establish and endow the greatest and most completely equipped agricultural and entomologcial investigating institution in the world.

We urge that the Trustees of the Planters' Association immediately take up this question of securing more efficient insect quarantine and inspection, with the Territorial Board of Agriculture. It would well pay the planters to offer to pay for all necessary additional plant and apparatus which might be required, until the expense could be regularly provided for by a legislative appropriation.

An ounce of prevention is worth a pound of cure. A bug which can be kept out by the expenditure of two or three thousand dollars a year, may destroy two or three million dollars worth of property if he once gets into Hawaii.

Moral: Keep the bugs out by every possible precaution. A cheap and easy precaution is to hold all imported plants in quarantine until they are proved to be insect free.

Second Moral: What is worth having is worth paying for.

INCREASED DEMAND FOR WHITE LABOR IN AUSTRALIAN SUGAR INDUSTRY.

MELBOURNE, Oct. 14, 1909.—The minister of customs has issued statistics showing the remarkable progress in the transformation of labor in the sugar industry from colored to white workers under the Federal bounty policy.

He shows that in 1902 only 32 per cent. of the production of the sugar industry in New South Wales and Queensland was the result of white labor, while in 1909 it is expected that over 90 per cent. of the production will have been the work of whites.—*Reuter.*

DECREASE IN UNITED STATES LUMBER CUT AND PRICES IN 1908.

The facts and figures contained in the forthcoming U. S. Census Bureau bulletin on lumber, lath, and shingles in 1908 disclose in most striking manner the adverse conditions obtaining in the lumber industry during that year.

A comparative summary of the total values for the several groups of forest products investigated for the calendar years 1907 and 1908 follows:

	1908	1907
Lumber, lath and shingles	$541,545,640	$707,095,409
Cross ties	56,280,568	78,958,695
Pulpwood	28,047,473	32,360,276
Tanbark and tanning extracts	21,361,719	21,205,547
Slack cooperage stock	16,900,651	15,800,253
Tight cooperage stock	14,406,443	19,807,370
Poles	5,928,824	8,081,763
Veneer	7,891,431	6,436,237
Wood distillation	5,899,426	8,196,181
Totals	$698,262,175	$897,941,736

The heavy decrease in the total value reported for 1908 reflects the ascertained falling off in the industry. As a result of the business depression, the quantity of lumber, 33,224,369 thousand feet, board measure, produced in 1908 was less than that for any other year for which reliable data are available since 1900.

The average cut of lumber per active mill shown by the reports for 1908 was but little more than 1,000,000 feet, as against nearly 1,400,000 feet per mill in 1907. The bulk of this decrease, it is stated, was undoubtedly due to smaller production.

The gradual rise in the average value is apparent from the fact that the price in 1900 per thousand feet at the mill for all the lumber produced was $11.13; in 1904, $12.76; in 1906, $16.54; in 1907, $16.56; with a drop back to $15.37 in 1908.

While there was an increase of 2,381 or 8.3 per cent. in the number of mills engaged in the production of lumber, there was a decrease of 7,031,785,000 feet, or 17.5 per cent., in the total quantity of the output. In the case of most of the States, reports were secured from a greater number of active mills for 1908 than for 1907, while on the other hand, the cut in 1908 was generally less than in 1907.

BEET SUGAR INDUSTRY IN VICTORIA.

Costly experiments were made years ago in endeavoring to produce beet sugar upon a payable basis in the State of Victoria, Australia. A splendidly equipped sugar factory was erected entailing a large monetary expenditure, but on account of the beet crops not receiving proper care, the industry collapsed and the abandoned mill fell into the hands of the local government. The building and machinery have been kept in excellent condition and the factory is ready to resume operations if the raw material can be procured.

Recently the Victorian government engaged Dr. Maxwell, of Queensland, who is considered to be the greatest authority on sugar in Australia, to inspect the factory and report upon the advisability of restarting the industry. His report criticized in strong terms the manner in which the industry was managed in Victoria before it collapsed. Mr. Maxwell's report is based upon conservative estimates; he expresses the opinion that the existing factory is capable of producing 4,000 tons of refined sugar a season and utilizing the beets grown on 2,500 to 3,000 acres under cultivation. He recommends that the growing of beets and the manufacture of sugar be revived in this State.

Based upon the results obtained in other countries, Dr. Maxwell made the following statements:

1. The production of beet and cereal crops in rotation have increased the yield in cereals by 50 per cent.

2. The farmer—desirous of always having 20 acres under beets—would require an area of 60 acres for the purpose, as beets can only be grown every third year on the same land.

3. The beet crops in the way of pulp would provide excellent fodder to dairy herds at a time of the year when such food would be exceptionally valuable.

PICKERING'S BORDEAUX MIXTURE.

The Hawaiian Planters' Record.]

Circular No. 8 of the Division of Pathology and Physiology recounted the results of an experiment designed to test the value of copper oxychloride as a fungicide for the treatment of cane cuttings. The experiment recorded here was carried out along much the same lines, but testing a new Bordeaux mixture recommended by Dr. S. U. Pickering.

According to Dr. Pickering's formula, a hundred gallons of the mixture can be prepared as follows: Dissolve 6 pounds 6½ ounces of copper sulphate in 2 or 3 gallons of water. Slack not less than 2 or 3 pounds of quicklime and stir the milk into 120 gallons of soft water. This mixture should be stirred at intervals and then allowed to settle, after which the required 86 gallons of clear limewater can be dipped off without disturbing the sediment. The copper sulphate solution is then added to the 86 gallons of limewater and the mixture brought up to the required 100 gallons by the addition of a sufficient quantity of water.

Dr. Pickering's study of Bordeaux mixture has led him to conclude that "the chief aim in making this mixture should be to reduce the lime to the lowest possible proportions consistent with the precipitation of all of the copper." His formula certainly calls for a minimum amount of lime, for 86 gallons of water cannot possibly carry in solution one pound of lime. All the accepted formulas for Bordeaux call for at least 4 pounds of lime to 6 pounds of copper sulphate and many authorities on the mixture prefer to use lime and copper sulphate in equal amounts, i. e., pound for pound. Dr. Pickering's mixture is certainly strong in copper sulphate for it quickly deposits a layer of copper on a knife blade or any other piece of steel that is immersed in it for a few moments.

In preparing Pickering's mixture two solutions are used, but as soon as they are mixed a finely divided precipitate is formed which settles more rapidly and more completely than the sediment in normal Bordeaux mixture. Moreover, it was found that the precipitate in Pickering's mixture does not adhere to cane cuttings as well as the solid matter of the normal Bordeaux.

The experiment, as arranged, covered twelve parallel rows of equal length. Seventy-two cuttings with two eyes each were planted in each row. Lahaina cane was used and two cuttings

only were taken from the upper end of each stick. These were prepared without shattering and the "Firsts" (top cuttings) were kept separate from the "Seconds". Each cutting was carefully inspected and only those with sound eyes were used.

This experiment was performed during July and August when the weather conditions were most favorable for the growth of cane, and the soil planted was of the best. The system of inoculation devised last year was again used. A pure culture of the pineapple fungus was obtained in a sugar solution. This solution, containing innumerable spores, was then sprayed over the ends of the cuttings with an atomizer. See Fig. 1. In this manner a most thorough inoculation was insured, and one far more severe than could possibly obtain under normal conditions on a plantation.

The cuttings in the various rows were treated as follows:

Not Inoculated:

Row 1. Untreated.
" 2. Soaked in Pickering's mixture for 1 hour.
" 3. " " water for 1 hour.
" 4. " " Pickering's mixture for 1 hour.
" 5. " " Normal Bordeaux for 1 hour.
" 6. " " Pickering's mixture for 1 hour.

Inoculated with pineapple disease:

Row 7. Untreated.
" 8. Soaked in Pickering's mixture for 1 hour.
" 9. " " water for 1 hour.
" 10. " " Pickering's mixture for 1 hour.
" 11. " " Normal Bordeaux for 1 hour.
" 12. " " Pickering's mixture for 1 hour.

This arrangement makes it possible to compare the germination in a row treated with Pickering's mixture, with the germination in an immediately adjacent row treated with water, Bordeaux mixture, or untreated. The first six rows allow this comparison for non-inoculated cuttings; and the last six rows permit of a similar comparison where the cuttings have been thoroughly inoculated with pineapple disease.

The data on which such experiments have been judged in the past by the Division of Pathology and Physiology have been obtained by counting, day after day, the number of primary shoots that appear above ground. This is continued until secondary shoots begin to appear. The results obtained represent quite accurately the number of eyes that have germinated. The germination figures obtained in this experiment at intervals of three and four days are shown in the chart on page 208. The germination counts for the first cuttings and for the second cuttings are indicated separately for each day, while the figures in the last column indicate the final per cent. of germination in the entire row.

The germination in rows 2, 4, and 6 when compared with that in 1, 3 and 5 clearly shows that Pickering's mixture injures the cut-

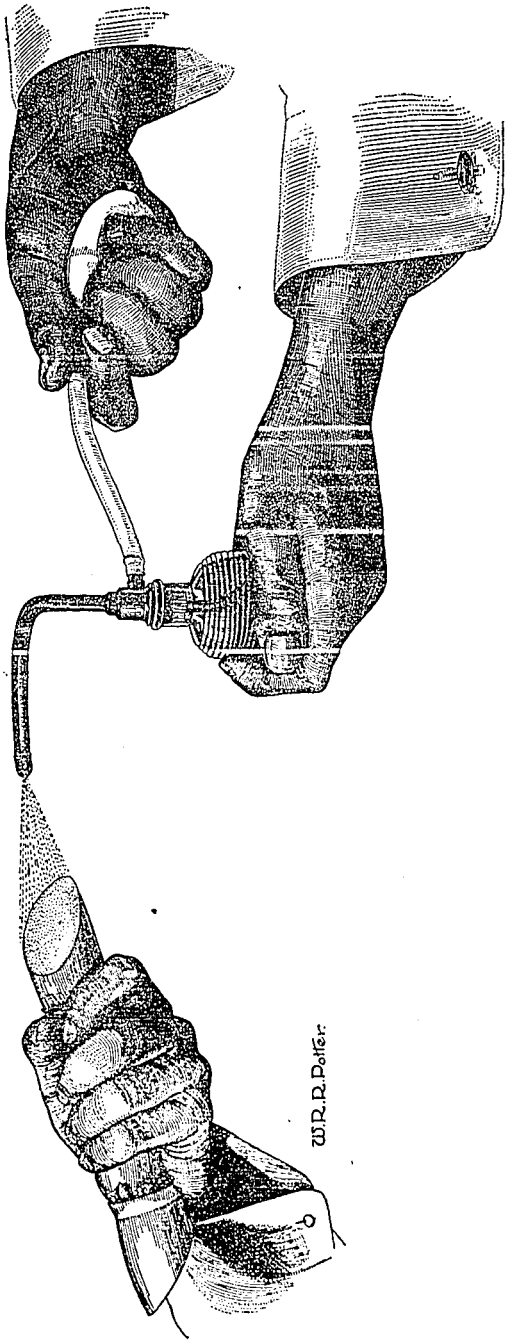

FIG. 1.—Showing method employed in inoculating cane-cuttings with pineapple disease.

tings to a very marked extent, over half of the eyes failing to germinate. This is also borne out by the exceedingly poor germination in rows 8, 10 and 12. Moreover, the fact that the germination in rows 8, 10 and 12 is much poorer than that in 2, 4 and 6 would indicate that the pineapple disease was able to enter the cuttings despite the presence of an excess of copper sulphate. An examination of the cuttings proved this to be the case.

Days after Planting.			10		13		17		20		24		27		Per Cent. Final Germination.
		Row	Firsts	Seconds	Firsts	Seconds	Firsts	Seconds	Firsts	Seconds	Firsts	Seconds	Firsts	Seconds	
Not Inoculated	Untreated.	1	5	13	27	26	54	37	56	44	57	47	59	49	75.
	Pickering's	2	0	0	8	10	24	22	30	28	30	38	32	41	50.7
	Water	3	28	20	51	36	59	44	60	49	61	50	61	51	77.77
	Pickering's	4	0	0	3	5	6	20	11	21	13	23	13	26	27.08
	Bordeaux .	5	38	20	66	43	67	52	67	52	67	53	67	53	83.33
	Pickering's	6	1	7	3	11	15	21	19	32	20	35	21	41	43.05
Inoculated	Untreated.	7	0	2	29	11	51	29	54	36	56	48	57	55	77.77
	Pickering's	8	0	0	0	0	1	5	4	7	5	19	7	27	23.61
	Water.....	9	12	4	31	17	46	34	48	37	50	47	53	50	71.52
	Pickering's	10	0	0	0	0	0	4	0	6	0	11	0	14	9.72
	Bordeaux .	11	26	22	61	52	64	63	65	66	65	67	65	68	92.36
	Pickering's	12	0	0	0	1	0	3	0	5	0	9.	0	15	10.41

This experiment proves conclusively that Pickering's formula should not be used in preparing Bordeaux mixture for the treatment of cane cuttings.

Aside from the main conclusions sought after, the results of this experiment afford some interesting observations. In the first place it shows that copper sulphate can materially injure or even kill the eyes of cane cuttings. Therefore in preparing Bordeaux for the treatment of cuttings, care should be taken that no considerable excess of copper sulphate is present in the mixture. This can be avoided by the use of a proper amount of lime.

Under conditions favorable to germination, the eyes of the first cuttings germinate better than the eyes of the second cuttings (note relative germination in odd numbered rows), but the eyes of the first cuttings are more susceptible to chemical injury than are the eyes of the second cuttings (note relative germination in even numbered rows).

It is interesting to note that the cuttings treated with normal Bordeaux mixture (rows 5 and 11) gave the best and most rapid germination.

A comparison of the germination in rows 7 and 9 with that in rows 1 and 3 would indicate that the pineapple disease does not materially affect the germination, and it is true that in this experiment it did not. In a very short time after the primary shoots had appeared above ground, however, it could be readily seen that their growth was appreciably retarded by the progress of the fungus in the cuttings. This is what we might expect from our knowledge of the habits of this fungus. It enters the ends of the cuttings and must work through the hard nodes before it can materially injure the growth of the shoots. During this time the shoots may have already gotten well above ground, providing the weather and soil conditions are favorable for the growth of the cane; and as we have already noted, this was the case at the Pathology plot during the time this experiment was being carried out. Should external conditions retard the germination, it is quite probable that the fungus would penetrate the nodes in many of the cuttings before the eyes had started, in which case the germination count would certainly show to the advantage of the non-inoculated cuttings.

The relative germination as determined by counting the primary shoots as they appear above ground should not, therefore, be considered a uniform or reliable basis on which to judge the possible injury caused by this disease. Moreover, it should not be employed as the basis on which to determine the relative protective value of various fungicides against the disease.

Final and convincing conclusions can only be reached in such experiments by growing the cane from the variously treated cuttings to maturity and determining the relative yields in sugar.

H. L. Lyon.

THE UTILIZATION OF ATMOSPHERIC NITROGEN, PARTICULARLY FOR THE MANUFACTURE OF AIR-SALTPETRE.

The Hawaiian Planters' Record.]

In view of the fact that nitrogenous fertilizers, especially nitrates, are of very great importance in the growing of sugar cane in these Islands, the following abstract of an address reported in the July (1909) number of the *"Journal of Industrial and Engineering Chemistry"* may be of interest.

The supply of nitrogen compounds has become a matter of great importance to agriculture, and this is a branch of economy on which the prosperity of nations depends to a large extent. The two most valuable compounds of nitrogen are ammonium sulphate and saltpetre.

Nearly all of the ammonium salts of commerce are obtained as by-products in the manufacture of gas and coke from coal and similar materials. At the present time the 26,000,000 tons of coal made use of yearly for this purpose in Germany yielded only about 260,000 tons of ammonium sulphate. Five times this quantity could be produced in Germany alone if all the coal used there were converted into coke, and this amount could be trebled or quadrupled if rational methods were used to convert the nitrogen into ammonia. The possibility has been advanced of obtaining a profit from the utilization of the large quantities of peat found in North Germany, and elsewhere, in the production of nitrogen compounds, in addition to gas as a source of power. It has been estimated that the German peat bogs should yield theoretically 360,000,000 tons of ammonium sulphate.

The second and most important source of combined nitrogen is Chili saltpetre. The export of nitrate from Chili for agricultural purposes began to assume large proportions at the beginning of the sixties, and at the present time nearly 2,000,000 tons are used annually. The yearly increase in the world's consumption amounts to at least 50,000 tons. A number of estimates have been made of the total quantity of saltpetre still in Chili; the most reliable figures vary from 120,000,000 tons down to 50,000,000 tons, a quantity which, with an annual increase in consumption as given above, would last from forty-two to twenty-one years.

From the consideration of such facts as these, Sir William Crookes, in 1899, prophesied that the supply of saltpetre would be exhausted before many years had passed and described the situation as an impending catastrophe. He also made the following important remark: "The fixation of atmospheric nitrogen is one of the greatest discoveries awaiting the ingenuity of chemists. It is certainly deeply important in its practical bearings on the future welfare and happiness of the civilized races of mankind."

Many celebrated chemists have been working for some time past on the problem of the fixation of atmospheric nitrogen. Their

efforts originate in the fact that the air can supply us with enormous quantities of nitrogen. Reckoning on the basis of the present annual consumption of saltpetre, there is sufficient nitrogen in the air for the production of fourteen thousand million years' supply of nitrate.

The different methods employed in the fixation of atmospheric nitrogen can be divided into three groups: First, the direct formation of ammonia from its elements, nitrogen and hydrogen, both of which have to be isolated for the purpose. The second group covers those processes in which the nitrogen is first isolated, and then converted into metallic nitrides and cyanogen compounds, which, in their turn, can be subjected to chemical reaction, and lead to the production of ammonia. The methods of the third group aim at the direct oxidation of atmospheric nitrogen and its conversion into nitrates and the like. In this case the air itself is used directly, and a previous isolation of the nitrogen is unnecessary.

The first method, the direct combination of nitrogen and hydrogen, presents great difficulties since at the high temperature at which the combination takes place a reverse action also sets in, and the ammonia formed is to a large extent decomposed back into its elements.

The second group of methods of fixing atmospheric nitrogen depends on the property of nitrogen combining with certain metals to form nitrides, or with metals and carbon to form cyanogen compounds, either simple or complicated. These nitrides and cyanogen compounds are then made to undergo a further chemical reaction, and give rise, on the one hand to ammonia, and on the other hand to metallic oxides and carbonic acid or other carbon derivatives. These methods consequently bring about an indirect synthesis of ammonia from its elements.

Recent investigations in Germany have shown that when nitrogen is made to react with carbon and barium carbonate, or with barium carbide, some barium cyanide is formed, but at the same time large quantities of another body are obtained which differs from barium cyanide in containing a smaller proportion of carbon. This body is barium cyanamide. If barium carbide be replaced by calcium carbide, it is found that the product contains no calcium cyanide at all, but that it consists chiefly of calcium cyanamide. The raw product contains lime and carbon as impurities, is black in color and has an unpleasant odor; but the chief point is that it contains 20 per cent. of fixed nitrogen. The product is now generally known as "Kalkstickstoff" or nitrolime.

Nitrolime may be applied directly to the soil as a fertilizer, in which case it is acted upon by soil bacteria giving rise to ammonia; and consequently, like the ammoniacal manures, it must be applied to the soil before the seed is sown, otherwise serious damage may be done to the crops. According to published researches it can only be used on special kinds of soils, such as heavy

absorbent ones. It is not suitable for moorland soils. It also produces different effects on the various classes of plants. The figures as to the quantitative results produced by cyanamides vary to a considerable extent. Wagner has come to the conclusion that the farmer should not pay for the nitrogen contained therein more than 80 per cent. of the price paid for an equal weight of nitrogen in the shape of Chili saltpetre, or in the saltpetre obtained from the air.

Great hopes have been laid on these processes and their further development, and quite a number of companies have been floated. It is, as yet, too early to prophesy with what success this industry will meet. It will also have to be decided whether the nitrolime is entirely suitable for application to the soil as such, or whether it will be advisable to convert it first into ammonium sulphate. It is interesting to learn that at Piano d'Orta, at the first nitrolime factory erected, a plant has already been put down for converting the calcium cyanamide into ammonium sulphate instead of using it as a manure, and, according to recent reports, other works are following this example.

The third method of bringing nitrogen into a state of combination, suitable for use on a practical scale, consists in converting it by direct oxidation into oxides of nitrogen which are then transformed into nitric acid and nitrates. Although nitrogen shows little tendency to enter into chemical reaction, it can, under certain conditions, be made to combine with oxygen.

The direct combination of nitrogen and oxygen is brought about by means of high temperatures, but the degree of combination is limited by the fact that the same temperature which brings about the formation of nitric oxide also tends to decompose it back again into its components. Only at a temperature under 1200° C. is nitric oxide stable against the action of heat, but at this temperature the amount formed is exceedingly small. Even at 1500° C., only one-tenth per cent. of the nitrogen in the air is converted into nitric oxide, and a very much higher temperature is necessary to bring about a reasonable degree of oxidation. Muthmann and Hofer, and especially Nernst and his pupils have closely studied the course of the reaction, and from their results it appears that at a temperature of 2200° C. the gases contain 1 per cent. of nitric oxide, at 2571° C. they contain 2 per cent., at 2854° C. they contain 3 per cent., and at 3327° C. they contain 5 per cent. Hence it is clear that in order to work profitably, the air must be heated to as high a temperature as possible, and then cooled down with the utmost rapidity, that as little opportunity as possible is afforded the nitric oxide to decompose again into its elements.

Electricity is a powerful means of bringing about the reaction because of the high temperature produced. All efforts in this field have been applied to the production of sparks or of electric arcs, and during the last decade an intense activity has been developed, both in the laboratory and also on the practical scale.

One class of scientists started by assuming that in order to use up the electrical energy to the best advantage, it should be distributed over a large number of small sparks or arcs. Bradley and Lovejoy founded their process on this assumption; and the Atmospheric Product Company was floated towards the end of the last century, with a capital of one million dollars, and carried out their process at Niagara, making use of power obtained from the Falls. They employed iron cylinders about 4½ feet high and 4 feet in diameter. In the axis of each of these a steel shaft rotated, containing, mounted one above the other, twenty-three zones of electrode arms, each zone containing six arms, and each arm being provided with a platinum sparking terminal. The wall of the iron cylinder formed the other electrode and was provided with a similar number of platinum terminals or poles, situated opposite to the terminals of the rotatable electrode. When the shaft was put into motion, the electrode poles attached to the ends of the arms came within sparking distance of the poles on the cylinder, and sparks sprang across from one pole to the other. As the motion of the shaft continued, the electrode poles were separated from one another, and the arc was drawn out and finally snapped, only to be formed again as soon as the next pair of poles came within sparking distance of each other. A direct current of 10,000 volts was employed and no fewer than 414,000 arcs or sparks were formed and extinguished every minute. Air was passed through the cylinder and so came in contact with a great number of arcs, each characterized by great length and extreme thinness, and consequently the air was enabled to attain rapidly the high temperature which is so necessary for the reaction, and was also cooled down again with great rapidity. According to Muthmann, the yield amounted to 430 kg. saltpetre per kilowatt-year; this yield, however, was somewhat small, and, coupled with the complexity of the apparatus and the expense of keeping it in order, as well as its initial expense, prevented the process being worked at a profit.

The first practical success in this direction was obtained in 1903 by Professor Birkeland in Christiania who worked in collaboration with the Norwegian engineer, Samuel Eyde. It was already known that if an electric arc, fed with an alternating current, be made to burn between the poles of an ordinary magnet, or of an electro-magnet which is excited by a direct current, the arc assumes the form of a disk. More correctly speaking, the arc is blown into a half disk at every half-period, but the impression on the eye is that of a quietly burning disk, like the sun. Birkeland and Eyde enclosed this disk in a flat ironclad furnace of fire-proof clay, and passed a strong current of air through it, and they thus obtained considerable yields of oxides of nitrogen, so that the prospects of being able to work their process on the technical scale appeared very bright. Since their first experiments the furnaces have gradually been increased in size, until those now used

are so large that each of them is fed with 700 kilowatts at a tension of 5,000 volts, and the disk of flame is over two yards in diameter. Each furnace uses up nearly 1,000 h.p., that is, one hundred times as much as those of the Atmospheric Products Company. The utilization of this large quantity of electricity in a single discharge constitutes the great difference between Birkeland and Eyde's process and those of earlier experimenters, who all attempted to make use of a very small current for each separate discharge, while employing an extraordinarily large number of flames, and consequently meeting with great difficulties in effecting an even distribution of the current.

The great importance attaching to the possibility of the fixation of atmospheric nitrogen had, several years before that time, been recognized in the Badische Anilinund, Soda Fabrik, and in 1897 special attention was paid to this new problem at the instigation of their head director. As a result of these labors, Otto Schönherr succeeded, in 1905, in discovering and, with the assistance of the engineer, Hessberger, working out a method of producing an electric arc; and was thus enabled to solve the problem in a surprisingly simple manner, presenting many advantages over the method of Birkeland and Eyde. It is not a mere modification of their process as has sometimes been falsely assumed, but differs fundamentally from it; for Schönherr dispenses entirely with magnets and magnetic fields, and produces his arc inside an iron tube of comparatively small diameter, at the same time passing air through the tube and thus bringing it into contact with the arc. The arc, as seen through a mica-covered opening, emits an intense light and is quite stable as opposed to arcs which are formed in the open air, since these latter are easily extinguishable. The air passing through the tube comes into contact with the arc, becomes partially converted into nitric oxide, and is then rapidly cooled down by contact with the outside layers of air. The cooling action is still further increased by surrounding the upper end of the arc tube with running water, after the manner of the Liebig condenser. The gases leaving the tube contain about 2 per cent. of nitric oxide, that is, from one and a half times to nearly twice as concentrated as are the gases which Birkeland and Eyde produce.

After the nitrogen has been converted into nitric oxide by any of the methods above referred to, the actual combustion of the nitrogen is completed; but on cooling the gases, as soon as the temperature reaches a certain point lying at about 600° C., the nitric oxide begins to combine with the excess of oxygen forming nitrogen tetroxide. The oxidation does not go past this stage of its own accord. The next step is to bring these oxides of nitrogen into a marketable state, that is, either into the form of nitric acid, nitrates, or nitrites. It would be very profitable to make nitric acid and nitrites, provided the consumption of these compounds were sufficiently great; but since the demand is limited, the chief aim of every large factory is to convert the supply of nitrogen

into the form of saltpetre, for which there is an unlimited market. Before the nitrogen tetroxide contained in the furnace gases, after they have been cooled, is capable of yielding nitric acid, it must be combined with a further atom of oxygen; and this combination is generally brought about by the action of water. The gases are passed through an absorption tower down which water is trickling, and during the reaction which takes places two-thirds of the nitrogen is converted into nitric acid, while one-third is regenerated as nitric oxide, which combines again with the excess of oxygen present in the gases forming nitrogen tetroxide; and this goes through the same course of reactions again. This constitutes the so-called "acid" absorption process. The absorbing liquid can be run down the tower several times, each time becoming richer in nitric acid, until a 40 per cent. product is obtained. On neutralizing this with soda, a concentrated solution of sodium nitrate is obtained and can be evaporated until the solid salt crystallizes out. On a practical scale, however, ordinary limestone is employed instead of soda, and calcium nitrate is obtained. This is at least as valuable as sodium nitrate for manuring purposes, and is consequently isolated as such and brought upon the market under the name of "Norwegian saltpetre" or "air-saltpetre."

The absorption at Notodden is at present carried out according to the "acid" process; the first product is dilute nitric acid, which is subsequently converted into calcium nitrate. The apparatus necessary is very extensive on account, both of the small amount of nitric oxide in the gases, and also of the very large volume of the gases treated. On leaving the electric furnace the hot gases are first made to pass through boilers, thereby giving up some of their heat, and creating the supply of steam used for heating the vacuum pans in which the solutions of calcium nitrate are evaporated. The gases are then still further cooled and afterwards passed into a large empty tower in which time and opportunity are given for the nitric oxide to be oxidized to nitrogen tetroxide. The gasses are then passed into very large granite towers, about 65 feet high, filled with lumps of quartz, and in these towers the acid absorption is effected by means of water, or of the dilute nitric acid, which is collected at the bottom of the tower. In order to recover the oxides of nitrogen which remain unabsorbed, the gases are finally treated with milk of lime or soda, and give rise either to a mixture of nitrite and nitrate, or to pure nitrite.

The calcium nitrate, obtained by means of the operations described, can, without further treatment, replace Chili saltpetre for the purpose of agriculture. Even a certain quantity of free lime, say 20 per cent., appears to have no harmful action on vegetable life, and the same remark applies to any calcium nitrite mixed with the nitrate.

Considerable quantities of air-saltpetre will shortly be put on the market, and probably within a few years the annual output will reach 100,000 tons. This quantity, however, is none too large

when we remember that the world's demand increases by at least that much every two years, and we need not expect any demoralization of the saltpetre market.

From the point of view of the agriculturalist, the industrial chemist, and the whole of mankind there is every reason to hope that the new process for the fixation of atmospheric nitrogen will continue to develop and flourish.

F. T. DILLINGHAM.

FORMULA SHOWING RELATION OF FIBRE TO JUICE IN SUGAR CANE.

In a recent address before the Barbados Agricultural Society, Dr. Watts, the Imperial Commissioner of Agriculture, as reported in the *Barbados Agricultural News,* presented the following formula and tables having reference to the relationship that exists between the percentage of fibre in canes, and the yields of juice and sugar that may be expected under different manufatcuring conditions. The fact that "three roll mills" and "muscovado sugars" are being still soberly discussed in the year 1909, indicates an extremely backward condition of the sugar business in Barbados. Hawaii would have gone into bankruptcy long ago under like conditions. Nine, twelve and even fifteen rolls are now the standard in Hawaii, Ewa having set the high pace, with great success.

"Our ideas concerning the composition of canes and the amount of juice which it is possible to obtain from them may be rendered much clearer by a very simple formula, which, although not perfectly accurate, affords approximations that are sufficiently near for our purpose.

The quantity of juice contained in a cane may be calculated approximately thus:

From 100, deduct one and one-third times the percentage of fibre in the cane, and the remainder will represent the percentage of juice in the cane. On this assumption we obtain the following:

10	per	cent.	of	fibre	=	86.7	per	cent.	of juice.
11	"	"	"	"	=	85.3	"	"	" "
12	"	"	"	"	=	84.0	"	"	" "
13	"	"	"	"	=	82.7	"	"	" "
14	"	"	"	"	=	81.3	"	"	" "
15	"	"	"	"	=	80.0	"	"	" "
16	"	"	"	"	=	78.7	"	"	" "
17	"	"	"	"	=	77.3	"	"	" "

A number of experiments have demonstrated that the ordinary three roller mill leaves in the megass from 150 to 180 parts of juice per 100 of fibre, or even more if very poor work is being done. The megass from a single mill with a cane splitter contains about 120 to 130. That coming from a train of mills consisting of a Krajewski cane crusher and two three-roller mills, in which

maceration is effected, contains from 65 to 70; while the megass coming from a train of mills consisting of a Krajewski cane crusher and three three-roller mills employing maceration may be reduced to a content of 25 to 30.

If we tabulate the results which may be obtained from various systems of milling as effected on canes of different fibre contents, we obtain interesting figures:

Type of Milling Plant.	Juice per 100 of fibre Megass.	Juice per 100 of cane when fibre content of cane is:—				
		10%	12%	14%	15%	16%
Bad single mill.....	200	66.7	60.0	53.3	50.0	46.7
Fair single mill.....	180	68.7	62.4	56.1	53.0	49.9
Good single mill.....	150	71.7	66.0	60.3	57.7	54.7
Cane splitter and single mill...	130	73.7	68.4	63.1	60.5	57.9
Krajewski and two 3-roller mills with maceration.....	70	79.7	75.6	71.5	69.5	67.7
Krajewski and three 3-roller mills with maceration.....	30	83.7	80.4	77.1	75.5	73.9
Krajewski and three 3-roller mills with maceration, best work	25	84.2	81.0	77.8	76.2	74.7
Total juice in cane.....	0	86.7	84.0	81.3	80.0	78.7

Such a table enables us to realize at once the enormous influence exerted by the fibre of the cane upon the quantity of juice which is obtainable. Thus, a good single mill will obtain from 71.7 to 54.7 per cent. of juice according as the cane contains from 10 to 16 per cent. of fibre. The table also enables us to see at a glance the influence, on the crushing of the perfection or imperfection of the mills employed.

In order to show the influence of the fibre in the canes, and the influence of the mill on the number of tons of cane required to make a ton of sugar, the following table has been prepared:

Table showing the tons of cane required to make 1 ton of sugar from canes of different fibre contents under different milling conditions, assuming juice to contain 1.95 lb. of sucrose per gallon.

Kind of Mill.	Fibre in Canes.		
	14%	15%	16%
Muscovado—Bad single mill.....	13.7	14.6	15.6
Fair single mill.....	13.0	13.7	14.6
Good single mill.....	12.1	12.6	13.3
Factory (Crystals)—Double crushing and Krajewski	8.8	9.1	9.3

All these figures justify the general conclusion that under conditions where 13½ tons of canes are required to make a ton of muscovado sugar, a ton of crystals can be made in a modern factory from 9 tons of canes. If the canes dealt with are of such a quality that more or less is required in one case, a corresponding amount more or less will be required in the other."